

SECTION 01240 - INSTALL REFERENCE CELLS

(Follow all instructions and make all edits with "Track Changes" turned on. This Section is not published in the Oregon Standard. If there are no instructions [purple text] above a subsection, paragraph, sentence, or bullet, then include it in the Project, unless the item(s) that are included in the subsection, paragraph, sentence, or bullet are not required on the Project and then they should be deleted. In general do not re-number or re-letter subsections when item(s) are deleted. Delete all purple text before preparing the final document. All other modifications to this Section will require ODOT Technical Resource and State Specifications Engineer approval.)

Section 01240, ~~which~~ is not a Standard Specification, and is included in this Project by Special Provision.

Description

01240.00 Scope - In addition to the requirements of Section 01201, Section 01210, Section 01215, Section 01235, Section 01245, and Section 01260, conduct corrosion potential surveys to determine reference cell locations and install permanent reference cells.

01240.01 Timing - Begin the Work of this Section only after the entire surface within the Work area has been cleaned to remove dirt, grease, oils, laitance, paint, sealers, coatings and other deleterious material according to Section 01260.

Do not start this Work until written approval of detailed procedures is received from the Engineer. Provide at least 24 hours' notice before the installation of each reference cell.

Make corrosion potential surveys in each zone only after the Work of Sections 01215, 01235, and 01245 is complete, and:

- All patches and new concrete have cured at least three Calendar Days.
- All curing compounds have been removed from patches and the adjacent concrete by abrasive blasting.

01240.02 Submittals - Submit detailed descriptions of all Materials according to 00150.37. Identify all relevant constituents and properties of each Material and the Specifications with ~~which~~ where it complies. Data published by the manufacturer is acceptable if testing was performed and reported by an independent test laboratory. This includes but is not limited to reference cell assembly, grout, and test Equipment.

Submit complete and detailed procedures for this Work according to 00150.37 at least 21 Calendar Days before the first scheduled Work under this item. Include the recommended reference cell conditioning procedures, Specifications, calibration certificates, and operating instructions for all Equipment, grout mixing, and wire labeling.

Submit a report according to 00150.37 detailing the following reference cell data:

- Pre-installation calibration potential of each reference cell after conditioning.
- Location of each permanent cell and labeling system for its lead wires.
- Circuit resistance measurements.
- Potential of each reference cell in its permanent location with respect to the rebar and the potential of a portable Copper/Copper sulfate (Cu/CuSO₄) or Silver/Silver Chloride (Ag/AgCl) reference cell taken in the test hole adjacent to the reference cell.
- Potential, with respect to the rebar, of a portable Cu/CuSO₄ or Ag/AgCl reference cell placed on the surface of the reference cell grout backfill.
- Resistance between each reference cell, the rebar adjacent to the reference cell, and the king bar.
- Potential of each reference cell in its permanent location with respect to the zinc anode placed directly over the reference cell grout.

Submit the following potential survey information according to 00150.37 at least 10 Calendar Days before installation of reference cells. ~~Furnish~~ Provide all potential survey data in an approved electronic format labeled to indicate the cathodic protection zone:

- One copy of large-scale potential survey data. Clearly identify data taken over patches or within three inches of patches. Provide a labeling method for survey grids and typical grid layout and survey procedures (e.g. origin location, direction in ~~which~~ where data was taken) in sufficient detail to allow interpretation of data.
- One copy of a summary of large-scale potential survey data. For each survey grid provide a location description, the number of data points collected, the average potential for the grid, the minimum potential in the grid, and a rank of the grid's minimum potential as compared to other grids in the zone.
- One copy (each) of maps of small-scale potential surveys, designating their location with respect to the original surveys and the location of rebar and potential readings. Provide surveys for each reference cell location plus one backup location for each reference cell. Scale these surveys with units indicated and use compass point directions and reference to the Bridge structural elements. Identify the cathodic protection zone. Show the precise location and orientation marks where the reference cells are to be installed.
- A summary sheet showing the grid number and location, rank of minimum potential and minimum potential from the large-scale grid survey, and the type of reference cell for each selected location. If additional locations with greater negative potentials are omitted, show the grid number, rank, minimum potential, and reason the location was omitted.

Do not start survey Work until these submittals have been approved by the Engineer.

Materials

01240.10 Reference Cells - Furnish two permanent Silver/Silver Chloride (Ag/AgCl) reference cells for each zone. ~~Furnish~~ the following reference cells or approved equal:

- Staperm by GMC Electrical, Inc. Model AG-4-UGPC

Furnish each reference cell with a #14 AWG wire having sufficient length to reach the junction box at the rebar connection location.

01240.11 Reference Cell Grout - ~~Provide~~Furnish non-epoxy grout from the QPL or an approved mix design provided by the reference cell manufacturer.

01240.12 Eyebolts and Anchors - ~~Provide~~Furnish 1/4"-20 threaded eyebolts designated for lifting constructed from Type 316 stainless steel. Provide a ~~M~~minimum eye diameter ~~shall be of~~ 3/4" and a minimum vertical lifting capacity ~~shall be of~~ 450 pounds.

~~Provide~~Furnish 1/4"-20 female threaded concrete anchors constructed from Type 316 stainless steel with a ~~M~~minimum pull-out and shear capacity ~~shall be of~~ 450 pounds tested in 4,000 psi concrete.

Equipment

01240.20 Resistivity Meter – Use one of the following resistivity meters:

- Fluke 1623 or 1625 GEO Earth Ground Tester
- Tinker & Rastor Model SR-2 Soil Resistivity Meter
- Miller 400A Analog Resistance Meter.

Construction

01240.40 Location Requirements - Identify two permanent reference cell locations in each cathodic protection zone. Install a Silver/Silver Chloride (Ag/AgCl) permanent reference cell at a location in each zone with the most negative potential. Install a second Ag/AgCl permanent reference cell at the maximum distance from the anode terminal plate but within 30 mV of most negative potential location. Locate each reference cell adjacent to a reinforcing bar.

Do not install the two permanent reference cells within 10 feet of each other measured along the surface of the Structure or within three feet of any galvanized steel in contact with the concrete. If the location with the most negative potential is also the most distant from the anode terminal plate, install the second Ag/AgCl cell at the location with the second most negative potential.

Identify a location for future linear polarization testing block outs adjacent to each reference cell location. Do not place the block out within 3 feet of a reference cell or negative connection excavation or within 10 feet of each other. Where possible, place the block out over the same reinforcing bar being read by the adjacent reference cell. Place at the most negative potential location possible while maintaining specified spacing from the reference cell excavations.

In each cathodic protection zone, conduct a corrosion potential survey with 36-inch grid spacing ("large-scale" survey) according to ASTM C876, "Standard Test Method for Half Cell Potentials of Reinforcing Steel in Concrete". Use a wetting solution of water and 0.2 percent sodium chloride by weight or 1.6 percent sodium chloride by volume.

Select prospective reference cell locations based on the most negative results of the large-scale corrosion potential survey. Perform a survey with 12-inch grid spacing ("small-scale" survey) of these locations directly over and following the reinforcing bar of the large-scale survey. Mark the precise location for the reference cell following the procedure described above in the first paragraph of this subsection.

Select final reference cell locations based on the most negative results of small-scale corrosion potential survey.

01240.41 Concrete Excavation Requirements - Excavate concrete for reference cell installation by carefully sawcutting or drilling to the rebar depth and then chipping out the concrete as specified in Section 01235 and as shown. Avoid disturbing the concrete around the adjacent reinforcing bar. In the event the concrete is disturbed, select a new location from the alternate sites.

Excavate concrete for rebar connections according to Section 01235 and as shown. Remove only as much material as necessary to weld a rebar terminal stub. Avoid contacting the rebar directly and de-bonding concrete surrounding the excavation. Install rebar terminals according to Section 01245.

Provide a 2-inch-diameter access hole for taking potential measurements with a portable Cu/CuSO₄ or Ag/AgCl reference cell, located opposite the rebar from the permanent reference cell and the same distance from the rebar. Make the access hole with a core drill to the depth of adjacent rebar. Insert a 1 1/2-inch diameter PVC plastic pipe inside the access hole and secure with reference cell grout. Extend the pipe two inches outside the concrete. If the access hole is located on a vertical surface, slope downward at approximately five degrees below horizontal. Install the pipe perpendicular to the surface on overhead, horizontal surfaces. ~~Provide~~ Furnish a removable threaded PVC or rubber cap to protect the hole from debris.

01240.42 Reference Cell Installation - Condition the reference cells as recommended by the manufacturer. Take potential readings in the conditioning solution compared to a calomel, Ag/AgCl, or Cu/CuSO₄ with a salt bridge. Clearly label each cell for identification along with its potential reading for future reference after installation. Provide a written description included in reference cell reports that indicates the location of each installed reference cell. Measure cell potentials.

Install each cell as soon as possible after removal from the conditioning solution to prevent its drying out. Wrap the reference cells in a suitable container to hold the moisture and protect the cell from contamination. Do not place the reference cell in contact with metallic dust.

Follow the manufacturer's instructions regarding any special backfill Materials required around the reference cell.

Place a layer of reference cell grout on all sides of reference cell before installing the cell in the excavation. Do not allow the reference cell to contact the rebar or other cathodic protection system components. Fill the excavation flush with the existing concrete surface by hand packing. Ensure that no air pockets remain. Take care to avoid damage to lead wires. Make bends in the lead wire with a radius no less than six times the lead wire diameter. Where the reference cell is to be placed along a non-horizontal bar, install with the lead wire end down.

Take reference cell-to-rebar resistance measurements after wet curing of the reference cell grout is complete, in the Engineer's presence, using a resistance meter ~~conforming~~ according to 01240.20.

Acceptable resistance values between reference cell and reinforcing bar are 5000 ohms or less. Reference cell installations with resistance measurements outside this limit may be rejected.

Take installed reference cell voltage readings using a voltmeter with an input impedance of at least one megohm. Take these readings between the permanent reference cell and the rebar and compare with the voltage between a portable Cu/CuSO₄ or Ag/AgCl reference cell in the access hole adjacent to the permanent cell and the rebar. Take these measurements in the Engineer's presence, within one hour of each other, after 7-Day wet curing of the reference cell grout is complete, and before any connection is made between the anode and cathode. Acceptable reference cell-to-rebar potential voltage reading is 75 ± 25 millivolts more positive than a Cu/CuSO₄ portable reference cell-to-rebar potential voltage measurement and ± 25 millivolts when using an Ag/AgCl portable reference cell. Reference cell installations with voltage measurements outside these tolerances may be rejected.

Support and protect wiring and rebar terminals from mechanical damage and corrosion during conduit installation and other construction until permanently enclosed in concrete, conduit, or junction boxes.

Mask future testing block out areas as shown. Install female threaded anchors on opposite sides of the block out areas, 180 degrees apart. Locate reinforcing bars and rotate anchors to avoid the bars. Install anchors according to manufacturer's recommendations using a rotary hammer and an approved insertion tool. Screw eyebolts 1/4 turn past hand tight and mask as shown.

Measurement

01240.80 Measurement - The quantities of reference cells will be measured on the unit basis.

Payment

01240.90 Payment - The accepted quantities of reference cells will be paid for at the Contract unit price, per each, for the item "Reference Cells".

Payment will be payment in full for furnishing and placing all Materials, and for ~~furnishing~~ providing all Equipment, labor and Incidentals necessary to complete the Work as specified.

No separate or additional payment will be made for corrosion potential surveys, submittals, future testing blockouts or eyebolt installation.